SIMULATED FIELD TRIALS USING AN INDOOR AEROSOL TEST CHAMBER

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As new and innovative methods are developed for detecting aerosolized biological weapons, these detectors must also be tested for accuracy, sensitivity and reliability. It is essential that these biological triggers are thoroughly tested before progressing to field testing as field trials are costly and time consuming.

A method for testing a Fluorescent Aerodynamic Particle Sizer (FL/APS), a biological trigger detector, with rapid turn around time was developed using a small, 12 m^3 aerosol test chamber. In this method, the aerosol chamber control software manipulates circulation fan speeds, chamber vacuum and agent spray times to produce a simulated dynamic cloud within the aerosol test chamber. This dynamic cloud mimics a deployed aerosolized biological weapon in the field with the leading edge, passing and tail end of the cloud. This method was developed using silicon dioxide to mimic the normal particulate concentration in the air and *Bacillus globigii* spores to mimic a *Bacillus anthracis* field release. A slit to agar biological sampler was used as a referee method for determining the agent containing particles per liter of air (ACPLA) during the course of the test. With the development of a dynamic cloud for an aerosol test chamber, it has been demonstrated that it is possible to use an aerosol test chamber as an effective and efficient method for testing biological triggers and has been employed commercially.

INTRODUCTION

Field testing is an effective method for determining the reliability, sensitivity and deployability of a biological trigger detector. However, field trials are very costly and time consuming. An alternative method for preliminary testing of biological trigger detectors was developed using an indoor aerosol test chamber. Aerosol test chambers have been used in the past for aerosol studies, but not for simulating field aerosol releases.

A software program, “Bio Cloud Simulator” was developed for an aerosol test chamber that would allow the user to create a customized agent cloud. The arrival, body and tail end of the cloud can be adjusted so that they mimic an actual agent cloud passing a unit in the field. This allows preliminary testing of biological trigger detectors in an indoor environment with repeatability and a rapid turn around time.

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MATERIALS AND METHODS

An aerosol test chamber was developed that would allow constant access to the equipment under test as well as the referee equipment. This was accomplished by constructing an elevated chamber off the ground. There are ports on the bottom of the chamber so the operator can access referee or reference equipment and systems under test at all times during aerosol sampling. The chamber is 12 m^3, which allows for more rapid change in particle concentration than can be achieved in a larger, more stable aerosol test chamber. This design is preferred, as it allows the user to quickly change the ACPLA in the chamber to simulate a passing biological cloud. Companion software was developed for the aerosol test chamber. This software not only controls pressure, air flow through the chamber and spray time, but also coordinates these parameters to allow the user to create a customized agent cloud that mimics an actual agent released in under field conditions. The aerosol test chamber does not control temperature and relative humidity because the majority of work is done with spores, which are not adversely affected by minor fluctuations in temperature and relative humidity. This information, however, is logged.

In order to simulate both the normal particulate concentration in the air and the biological cloud, two solutions are dispersed from separate Hudson nebulizers. A silicon dioxide solution was to simulate outdoor background particles and *Bacillus globigii* spores were used as a biological simulant.

In order to referee chamber tests, two New Brunswick Slit to Agar Samplers were run for two minutes consecutively, providing the user with four minutes of data. The slit to agar samplers are the referee equipment of choice because they provide not only biological particle concentration information in the form of ACPLA, but they also allow the ACPLA information to be correlated back to certain points of time throughout the test.

RESULTS AND DISCUSSION

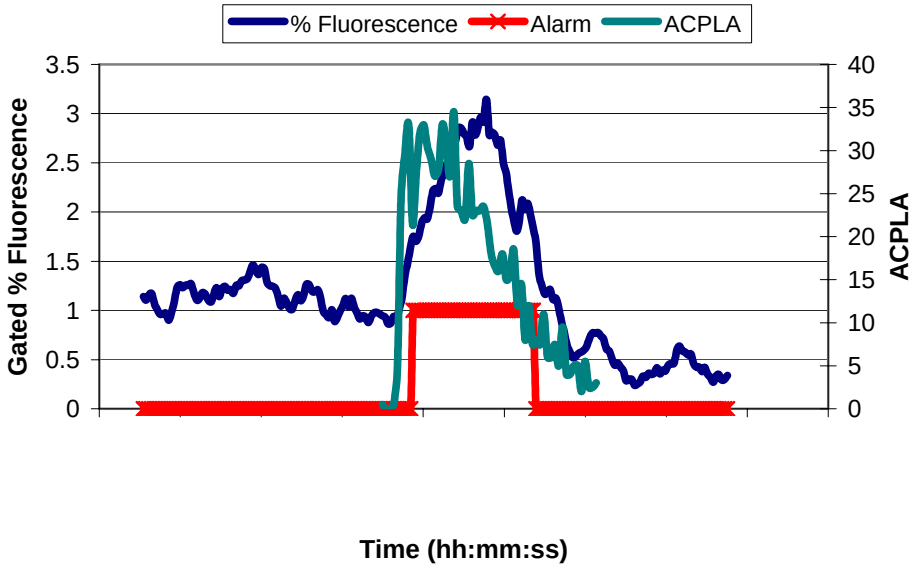

Figure 1. Bioaerosol data collected during a test in the Aerosol Test Chamber. The fluorescence intensity is determined by the FL/APS and the alarm indicates that the unit has detected biological particles. The ACPLA is the referee data collected by Slit Samplers.

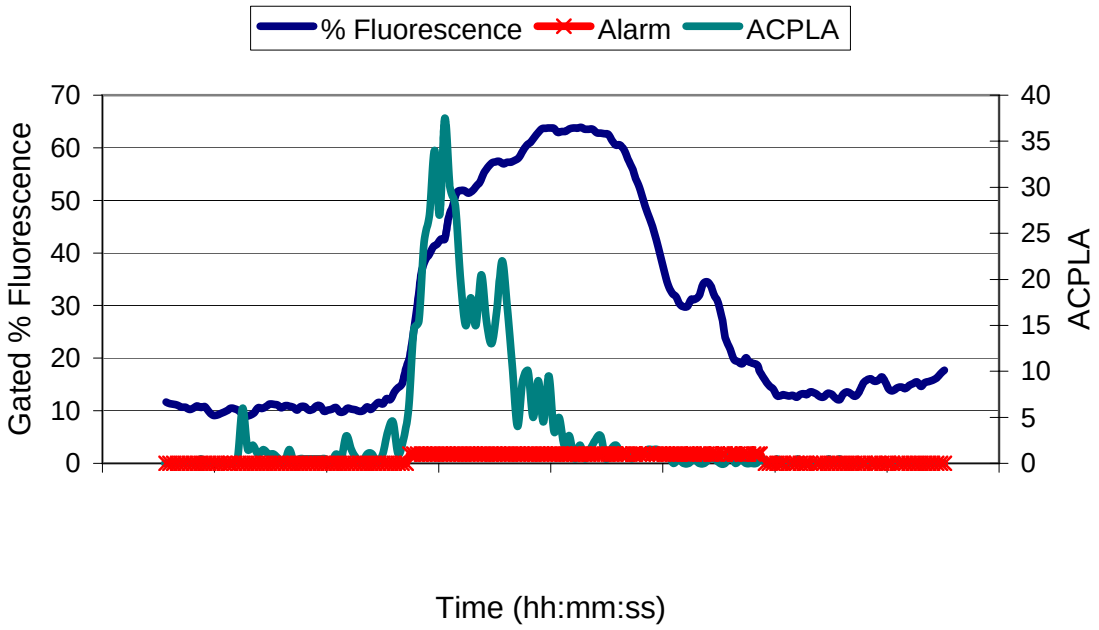

Figure 2. Bioaerosol data collected during a field trial. The fluorescence intensity is determined by a FL/APS and the alarm indicates that the unit has detected biological particles. The ACPLA is the referee data collected by Slit Samplers.

As shown in Figures 1 and 2, the biological clouds in both field and chamber environments have a similar shape. In both situations, the rise time of the bioaerosol cloud is very rapid, while the tail end of the cloud has more of a lag time. This demonstrates that an aerosol test chamber can be used for preliminary testing of biological detection systems.

There are a variety of applications for this technology. With an increasing number of biological detection systems being designed, this testing method allows designers to challenge their equipment with repeatable and controllable tests that have a quick turnaround time. Although this testing method was developed for a fluorescence-based detector, it can be used for other biological detection methods as well. Other referee systems such as an All Glass Impinger (AGI) can also be used in lieu of a slit to agar referee system. In addition to testing detection equipment, new alarming algorithms developed for biological triggers can be tested in a repeatable, low ACPLA environment. The aerosol test chamber can also be used to calibrate biological detection systems under controlled conditions.

While the Aerosol Test Chamber is useful for testing biological detection systems, it does not eliminate the need for field-testing. There are many conditions such as weather, type of release, climate, time of day and season that affect the release of an aerosolized biological cloud and cannot be simulated in the current aerosol test chamber design.

Research is currently being done to determine the feasibility of allowing the operator to draw outside air into the aerosol test chamber. This would eliminate the need for silicon dioxide dispersal and provide a more realistic background particle signature and concentration.

SUMMARY

The aerosol test chamber software and hardware system was developed to reliably reproduce various controlled biological cloud morphologies, making it a cost and time effective means of producing aerosol threat conditions for initial developmental and operational test on biological triggers/detectors. Research

is currently being performed to include the introduction of outside background air and other simulants for agents of biological origin.